RIVET TOOL WITH REMOTE INTENSIFIER AUTO FILL/RECHARGE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/422,555, filed on October 29, 2002. The disclosure of the above application is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] One field of the present invention relates generally to riveting machines and, more particularly, to a riveting system having a hydraulic remote intensifier with an auto-fill/recharge system and methods for operating the riveting system.

BACKGROUND OF THE INVENTION

[0003] The present invention relates to a blind rivet comprising a tubular rivet body in which is mounted a mandrel having a head portion at the narrow end of the stem so that when the mandrel is pulled back in the rivet, it upsets the rivet. When pulling-back of the mandrel is resisted with a predetermined force, the mandrel breaks off. A riveter that operates with such rivets typically has a housing formed at its front end with an aperture through which the rivet mandrel is engaged. Within the housing is a chuck that engages tightly around the mandrel and an actuating mechanism or pulling head which

pulls the chuck backwardly, thereby upsetting the rivet and breaking off the mandrel.

[0004] In rivet setting machines, the operator sets a rivet held in the nose of the rivet tool by pulling a trigger. The remaining spend mandrel is drawn through the tool and through a collection tube into a collection box. A proximity switch senses the spent mandrel just before it enters the collection box.

[0005] There are a variety of different types of tools, both manual and powered, that are used to set pull-type blind fasteners. For industrial production, it is desirable to use a power tool that may have an air/hydraulic or electrical power assist to pull the mandrel stem. This facilitates the rivet setting operation.

[0006] It is known to automate the process of feeding rivets to the riveter tool, as for example shown in U.S. Patent Nos. 6,240,613, 4,754,643, and 4,747,294, commonly assigned. It is also known to automate the mandrel collection process as taught, for example, in U.S. Patent No. 4,972,985, also commonly assigned. The most common approach to automatic rivet feed and disposal uses hydraulically or pneumatically powered mechanisms for guiding blind rivets to the riveting tool and extracting broken off mandrels therefrom.

[0007] Common shortcomings of prior art apparatus for auto-feeding of rivets to the riveting tool is the potential of such systems to leak hydraulic fluid during maintenance, service and change-over. In addition, ways are constantly being sought which speed up the set-up capabilities as well as speeding up the rivet setting process.

SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to overcome the deficiencies described above. As such, what is disclosed is a rivet setting tool having a hydraulically driven pulling head for engaging a mandrel of a rivet and upon actuation, resetting the rivet. The rivet setting tool has a hydraulic pressure source coupled to the riveting head and an intensifier operably coupled to the hydraulic pressure source. A hydraulic refill system is coupled to the hydraulic pressure source which is configured to apply pressure to the hydraulic pressure source to cause the charging of the hydraulic system upon maintenance or refilling of the rivet setting head of the hydraulic system.

[0009] In one embodiment of the present invention, a rivet setting tool is provided having a pulling head which has a hydraulic piston coupled to a rivet engaging jaw. A pneumatic intensifier defining a hydraulic pressure source is coupled to a hydraulic passage which is in turn coupled to the hydraulic piston. The hydraulic pressure source has a pneumatically actuated piston which is coupled to a rod which is slidably received within a ram housing. The ram housing is fluidly coupled to the hydraulic passage. The intensifier further has a baffle which divides an intensifier cavity into a hydraulic fluid source and a first cavity. The hydraulic fluid source is fluidly coupled to the ram housing when the rod is in a fill position and substantially fluidly sealed from the ram housing when the rod is in an actuation position within the ram housing. Application of air pressure to a first side of the piston causes hydraulic pressure to be applied to

the hydraulic piston. Application of air pressure to a second side of the piston allows the rod to move from the actuation position to a filled position.

[0010] In another embodiment of the invention, a rivet setting tool having a pulling head including a hydraulic piston is provided. An intensifier having a hydraulic pressure source is coupled to the hydraulic piston. The intensifier has a refilling mechanism which when actuated fluidly couples a source of hydraulic fluid to the hydraulic piston. The intensifier further has a means for applying hydraulic pressure to the hydraulic passage to actuate a rivet setting mechanism.

[0011] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0012] Figure 1 represents a system overview of the rivet setting system according to the teachings of the present invention;

[0013] Figure 2 represents a subassembly of the rivet setting system in its actuation position;

[0014] Figure 3 represents a view of the rivet setting system shown in Figure 1 in its fill position; and

[0015] Figure 4 represents the recharging or filling of the hydraulic system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0017] With reference to Figure 1, the fastening system 10 according to the present invention is shown. Shown is a rivet setting tool 12 operably coupled to an electronic controller 14, hydraulic controller 16, a pneumatic controller 18, a rivet feeder 20, a remote hydraulic intensifier 22, and a mandrel collection system 24.

[0018] The rivet setting tool 12 includes a pulling head 44 which includes a hydraulic piston 46 within a machined aluminum housing 48. The hydraulic piston 46 is connected to jaw case 50 via a coupling so that during activation, i.e., hydraulic pressure supplied by a hydraulic hose 52 on the face of the hydraulic piston 46, the jaws 51 ramp off a nose piece, and engage the rivet mandrel. Continued travel provides enough force and stroke to effectively set the average rivet. The pulling head 44 employs air pressure via pneumatic tube 54 on the opposite side of the hydraulic piston 46 to return the hydraulic piston 46 to its full forward position once hydraulic pressure is removed.

[0019] The hydraulic supply hose 52 is connected to the remote intensifier 22. As shown in Figure 2, the remote intensifier 22 includes an intensifier chamber 56 which is defined within an intensifier chamber body 58. An air piston 60 is slidably received in the intensifier chamber 56 and is provided with a seal 62 which engages intensifier chamber body 58. A rod 64 is attached to air piston 60 and extends through a sealed cylindrical opening aperture defined through an intensifier chamber intermediate baffle 66 and into a cylindrical opening defined in a ram housing 68 which is filled with hydraulic oil 70. A seal 72 is further provided between the rod 64 and the ram housing 68 which substantially fluidly separates the intensifier chamber 56 from a bore 67 defined by the ram housing 68. A source of pressurized air in the form of pneumatic tube 74 is connected to a valve 76 which is connected to a first quick dump exhaust valve 78 which communicates with a first end of intensifier chamber 56. A second supply of pressurized air in the form of a second pneumatic tube 80 is provided in communication with a second end 84 of intensifier chamber 56. A second quick dump exhaust valve 82 is provided in communication through line 104 with the second portion 84 of intensifier chamber 56. The ram housing 68 is connected to the hydraulic hose 52 by a plurality of fittings.

[0020] Air pressure applied to the air piston 60 forces the rod 64 to displace a column of hydraulic oil 70 with a smaller cross-sectional area. The volume of air acting on the area of the piston forces the air piston 60 and rod 70 upward. The differential in area between the air piston 60 and the top of the rod

70 allows the generation of a high hydraulic pressure from a low air pressure. As the air piston 60 moves upward, first exhaust dump valve 78 opens to vent air building up on top of air piston 60. The high pressure column of oil 70 flows through the hydraulic hose 52, and forces the pulling head hydraulic piston 46 of pulling head 44 back, thus setting the rivet. During operation, should the fluid level become low, fluid flows through open hydraulic system port 59 to replenish the fluid supply within bore 67.

[0021] Upon mandrel break, the controller 16 stops activating the valve 76, and starts activating a remote valve (not shown) supplying a regulated supply of air through quick dump exhaust valve 82 and on top of air piston 60. The combination of the air behind the pulling head piston 46 of the pulling head 44 disposed within the rivet setting tool 12, and the air bubble on top of the air piston 66 quickly returns the pulling head 44 and jaw case 50 to the retracted position. The venting of the second portion 84 of the intensifier chamber 56 to atmosphere limits that possibility by limiting pressure build up. Air supply to the top of the air piston 60 is controlled by the riveting system controller 14 and shuts off after approximately one second.

[0022] Figure 3 represents the system 10 of the present invention in its automatic refill mode. Upon actuation of the refill feature by an operator, the electronic controller 14 functions to prompt the operator to open the bleed screw 100. After confirmation that a bleed screw 100 has been opened, the electronic controller 14 functions to send a signal to the pneumatic controller 18 to begin the refill process. Pneumatic pressure is now directly applied to a top surface

102 of the air piston 60 through pneumatic line 104. In this regard, air pressure is supplied by a pneumatic line 104 to a first cavity 106 formed between the air piston 60 and the baffle 66. Air pressure is applied so as to retract the rod 64 to a refill position 108, so as to allow the fluid coupling of a hydraulic source 110 with the ram housing 68.

[0023] As shown, a check valve 88 is fluidly positioned between the hydraulic fluid source 110 and the bore 67 of the ram housing 68. The check valve 88 is positioned at a proximal end 114 of the ram housing 68. Additionally, the ram housing can define a second aperture (not shown) to fluidly couple the hydraulic fluid source 110 to the ram housing 68. The second aperture can optionally have a check valve which allows the flow of hydraulic fluid from the fluid source 110 into the bore 67, while closing the fluidly coupling between the ram housing bore 67 to the hydraulic source when the rivets are being set. The rod 64 and intermediate baffle seal 72 fluidly separate the first cavity 106 from the hydraulic fluid source chamber 112.

[0024] As seen in Figure 4, once the bore 67 defined by the ram housing 68 is fluidly coupled to a source of hydraulic fluid 70, air pressure is supplied directly through pneumatic line 80 by the pneumatic controller 18 so as to supply hydraulic oil 70 through the ram housing 68 and into the hydraulically actuated rivet setting tool 12 to charge the hydraulic lines. Differential pressure opens check valve 88 to fluidly couple the hydraulic fluid source 110 with the bore 67. Specifically, pneumatic pressure is applied into the hydraulic fluid source chamber 112, between an upper surface of the hydraulic fluid 70 and the

top surface 116 of the hydraulic source chamber 112. This pressure forces the hydraulic fluid through the check valve 88 located at the proximal end 114 of the ram housing 68 into the bore 67.

[0025] After sufficient hydraulic fluid 70 has escaped through the bleeder screw 100, the operator stops the recharging cycle by pressing a button on the electronic controller 14. The system 10 then applies pneumatic pressure to a bottom surface 120 of the air piston 60 through a pneumatic line 122 coupled to the bottom of the remote intensifier 22. This returns the air piston 60 to its actuation position 122, thus resetting the rod 64 into the ram housing 68 as shown in Figure 2.

[0026] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.